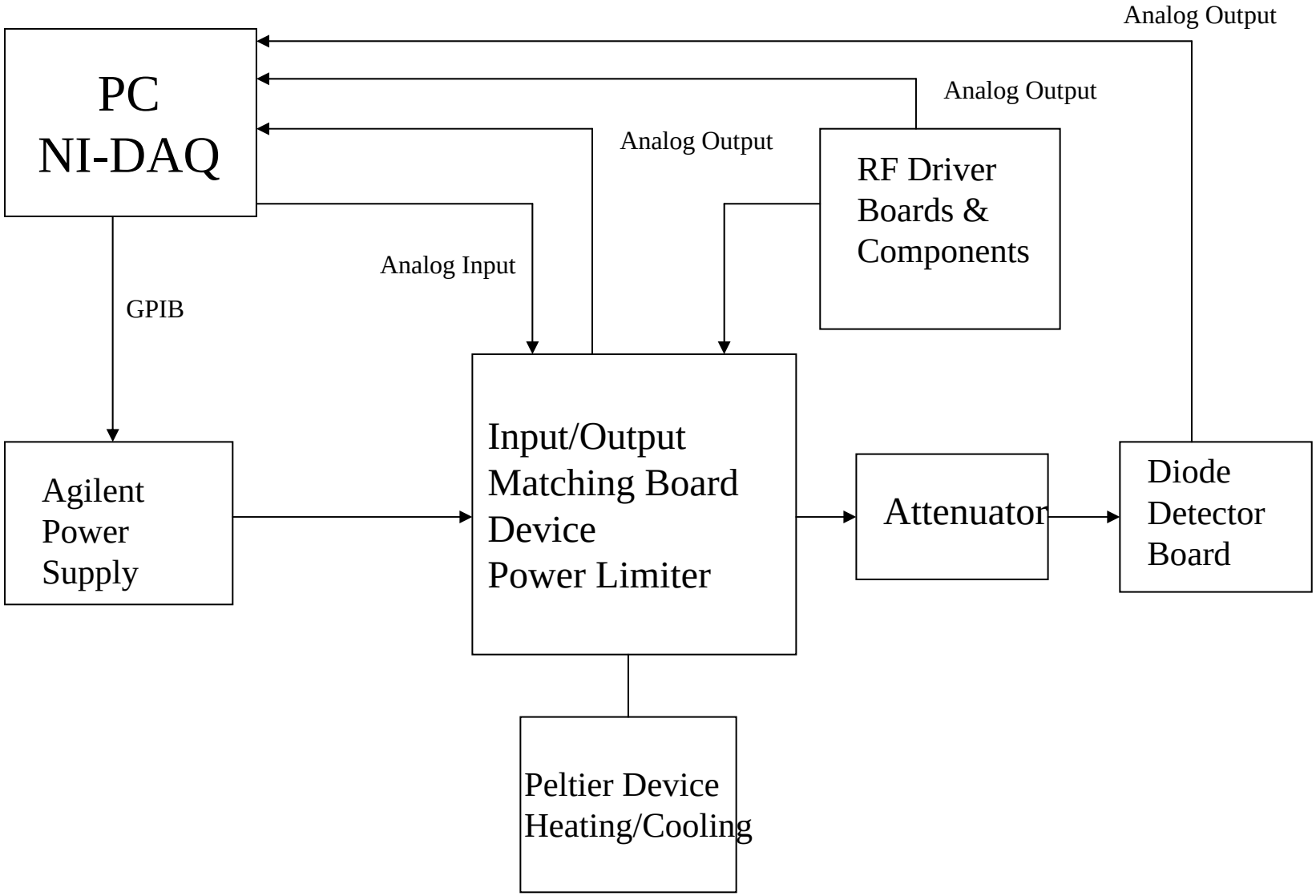
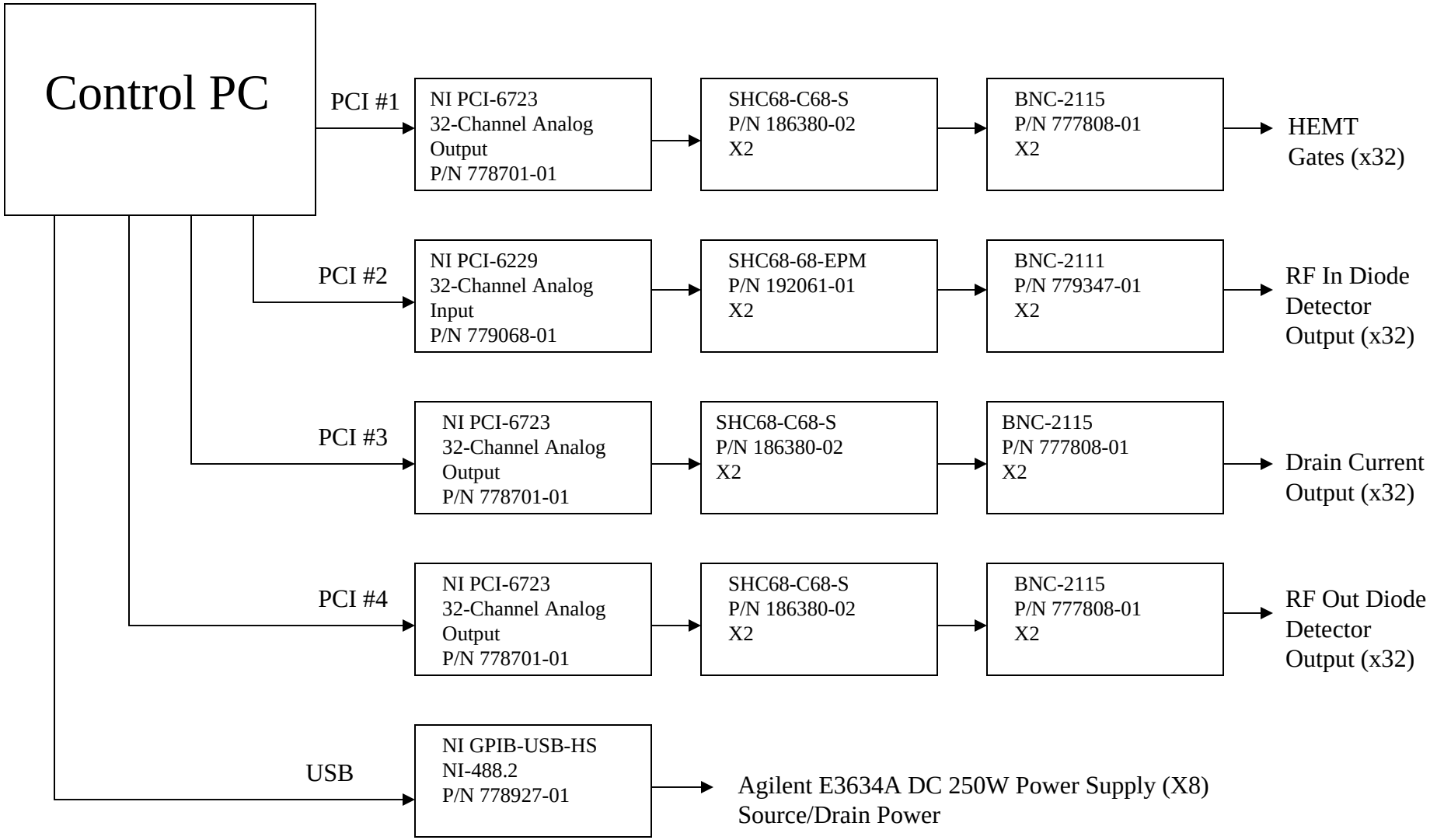
RF Reliability Test Stand

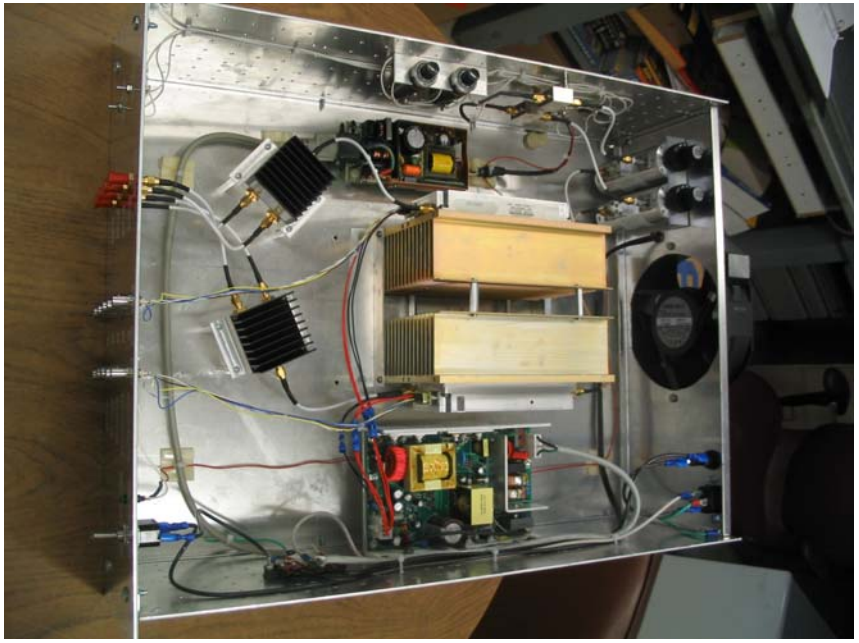


LabView Control Environment

PC I/O DAQ


Control PC
PCI #1
NI PCI-6723
32-Channel Analog
Output
P/N 778701-01
SHC68-C68-S
P/N 186380-02
X2
BNC-2115
P/N 777808-01
X2
HEMT
Gates (x32)
PCI #2
NI PCI-6229
32-Channel Analog
Input
P/N 779068-01
SHC68-68-EPM
P/N 192061-01
X2
BNC-2111
P/N 779347-01
X2
RF In Diode
Detector
Output (x32)
PCI #3
NI PCI-6723
32-Channel Analog
Output
P/N 778701-01
SHC68-C68-S
P/N 186380-02
X2
BNC-2115
P/N 777808-01
X2
Drain Current
Output (x32)
PCI #4
NI PCI-6723
32-Channel Analog
Output
P/N 778701-01
SHC68-C68-S
P/N 186380-02
X2
BNC-2115
P/N 777808-01
X2
RF Out Diode
Detector
Output (x32)
USB
NI GPIB-USB-HS
NI-488.2
P/N 778927-01
Agilent E3634A DC 250W Power Supply (X8)
Source/Drain Power

RF Power Supply (x4)



Tuning: 2 GHz =
8 VDC

Power Supply:
15.0 V, 45.0 mA

DC Power

Power Splitter
1:2

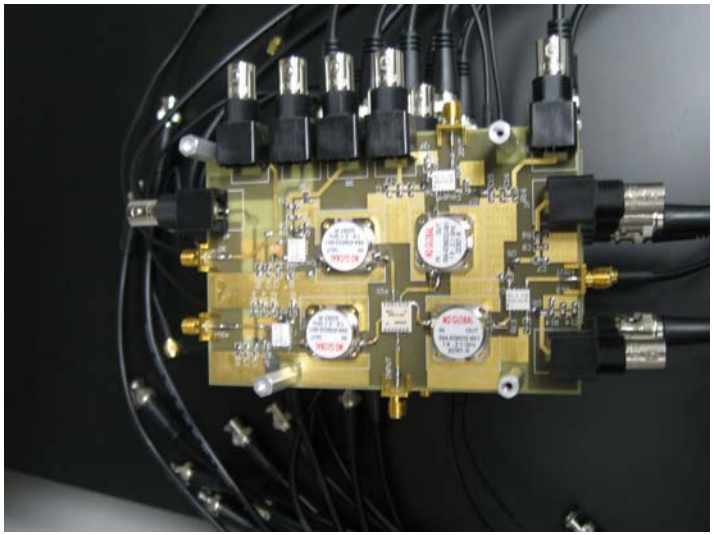
5 W Output

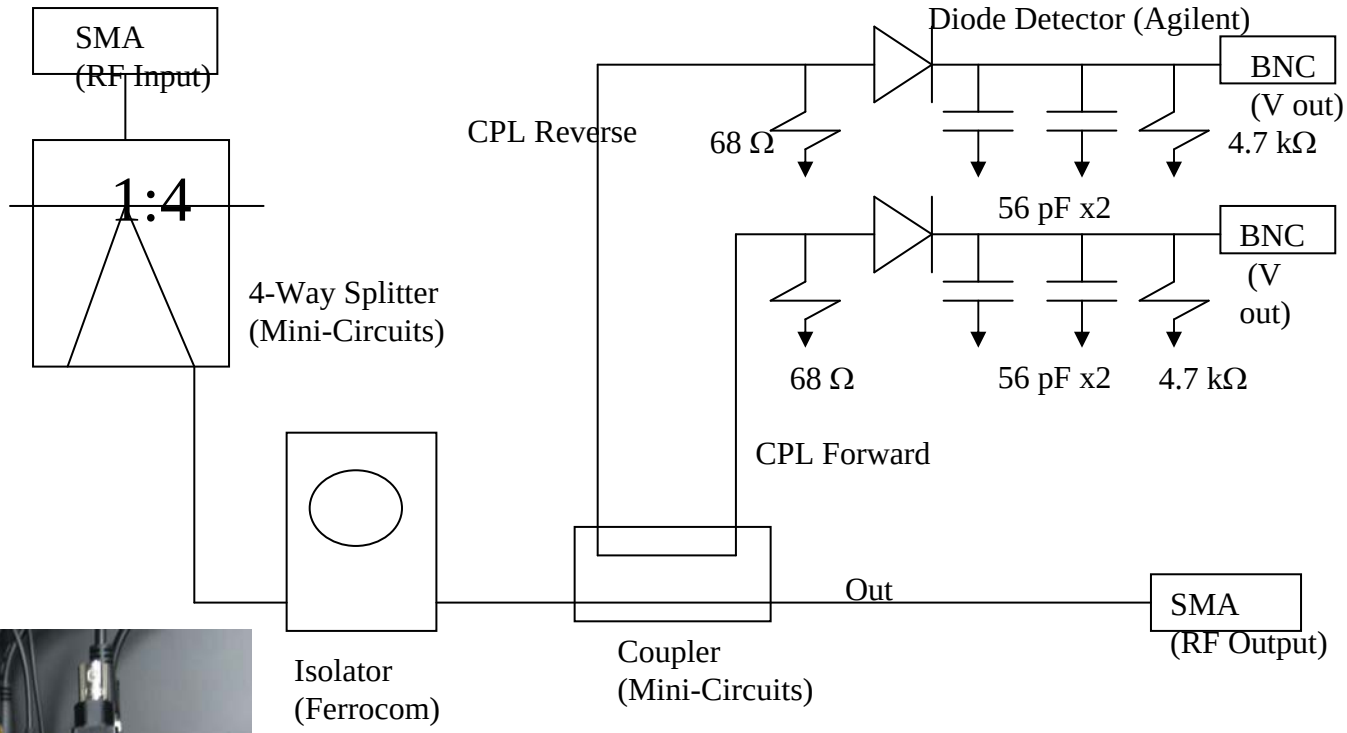
Voltage Controlled Oscillator (VCO)
(Spectrum Microwave)

Variable Attenuator
(JFW Industries)

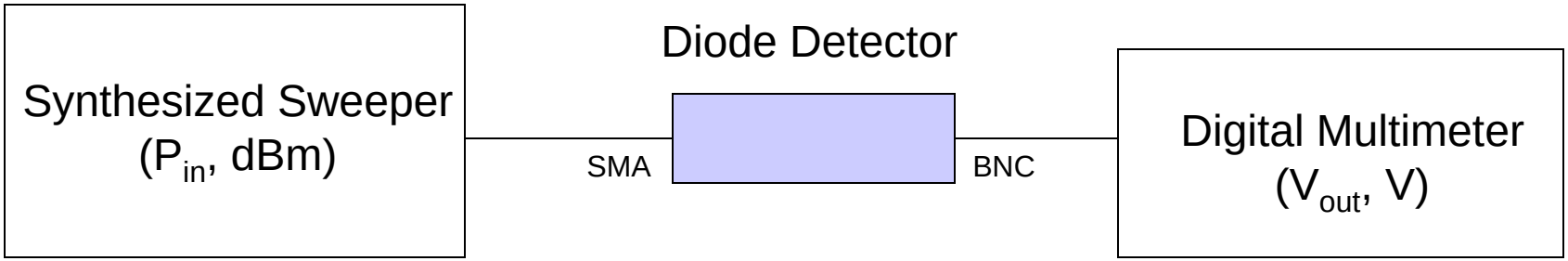
40 dB Amplifier
(Empower)

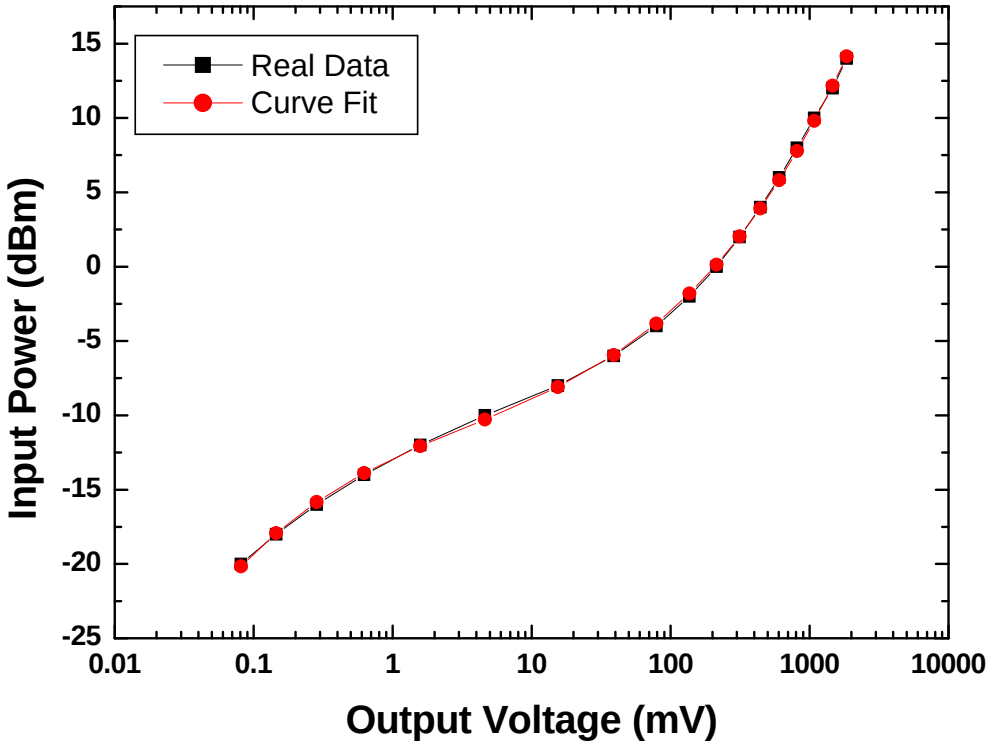
RF Splitter Board Detail (x8)





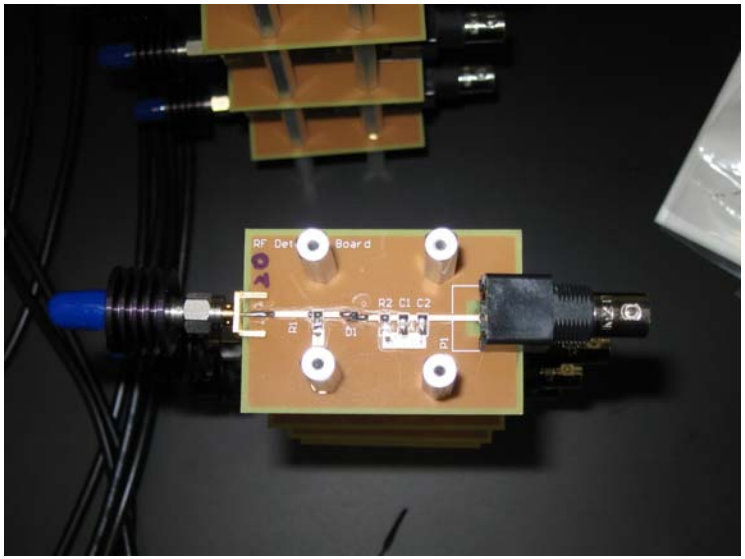
Detector Board Characterization



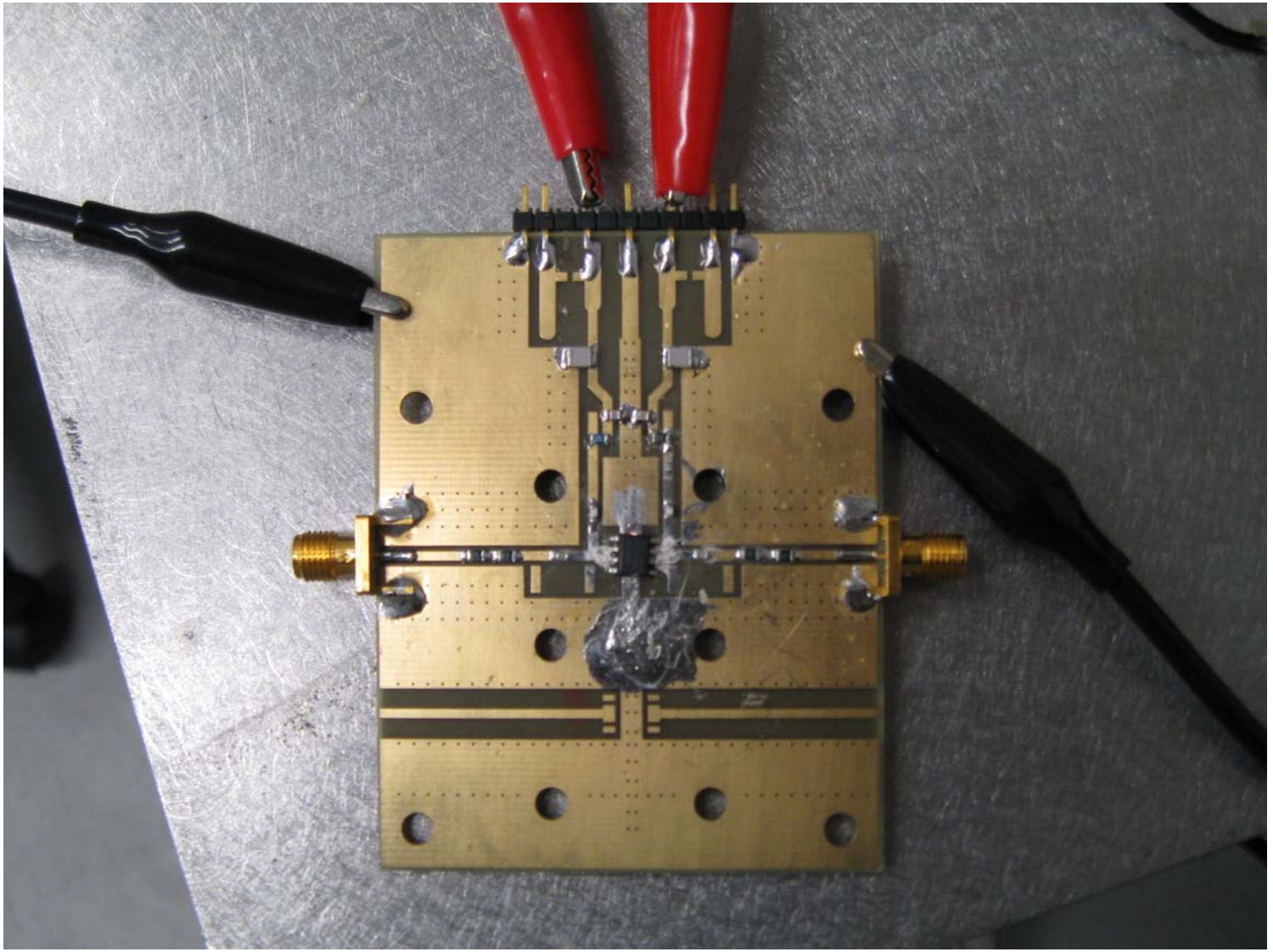


At 2 GHZ:

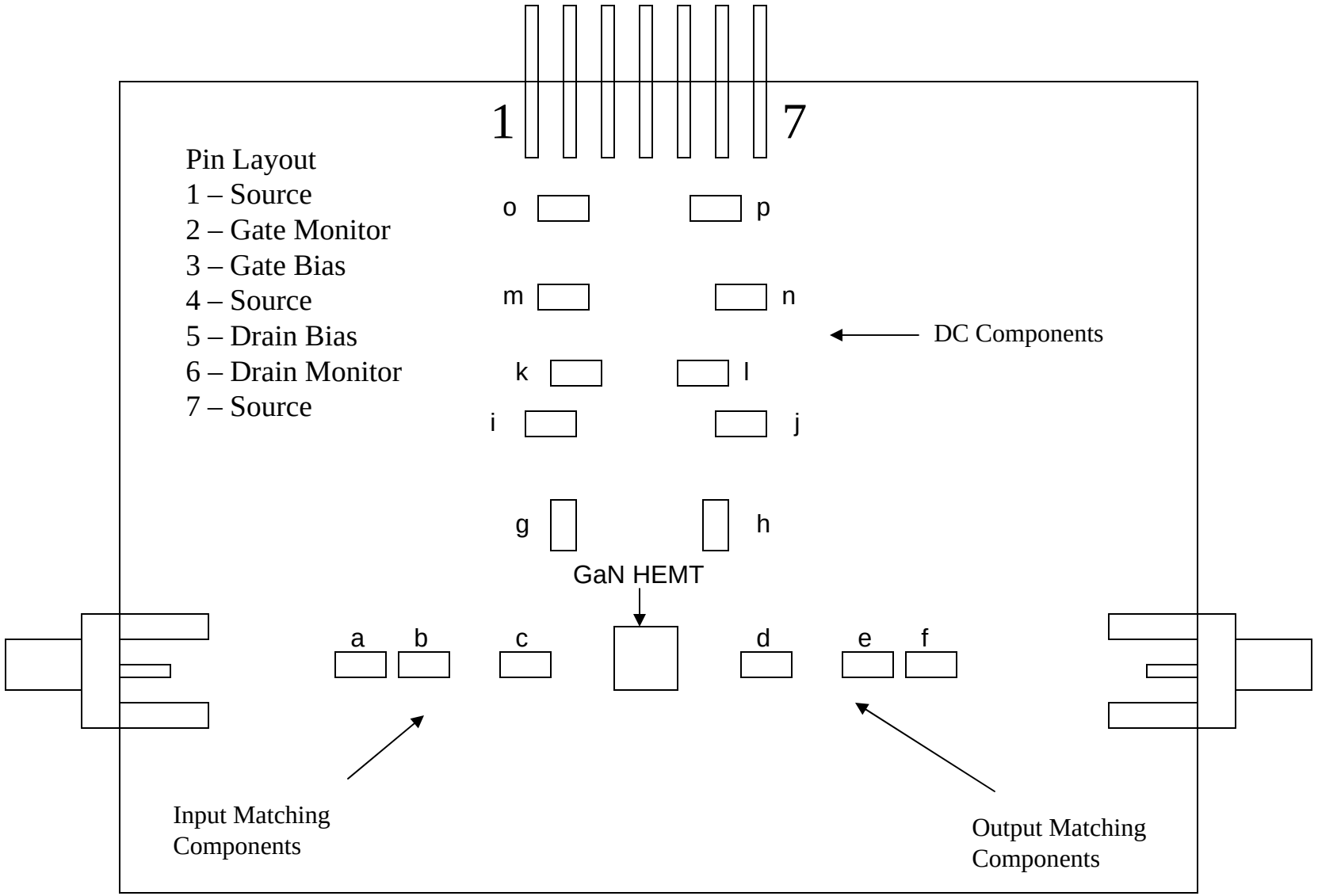
$P=a[\ln(bV)]^3+c[\ln(bV)]+d$



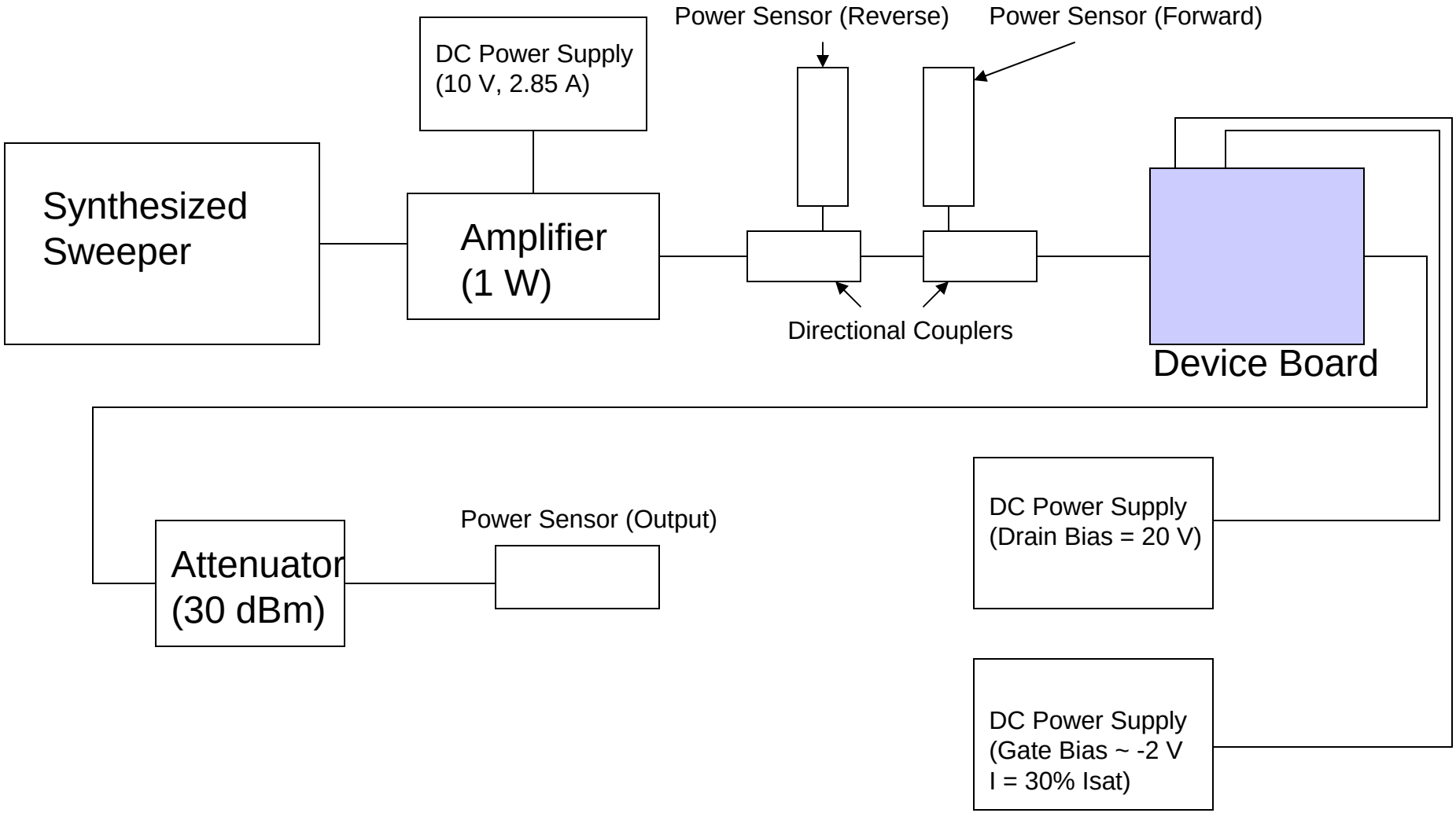
Device Board Photos



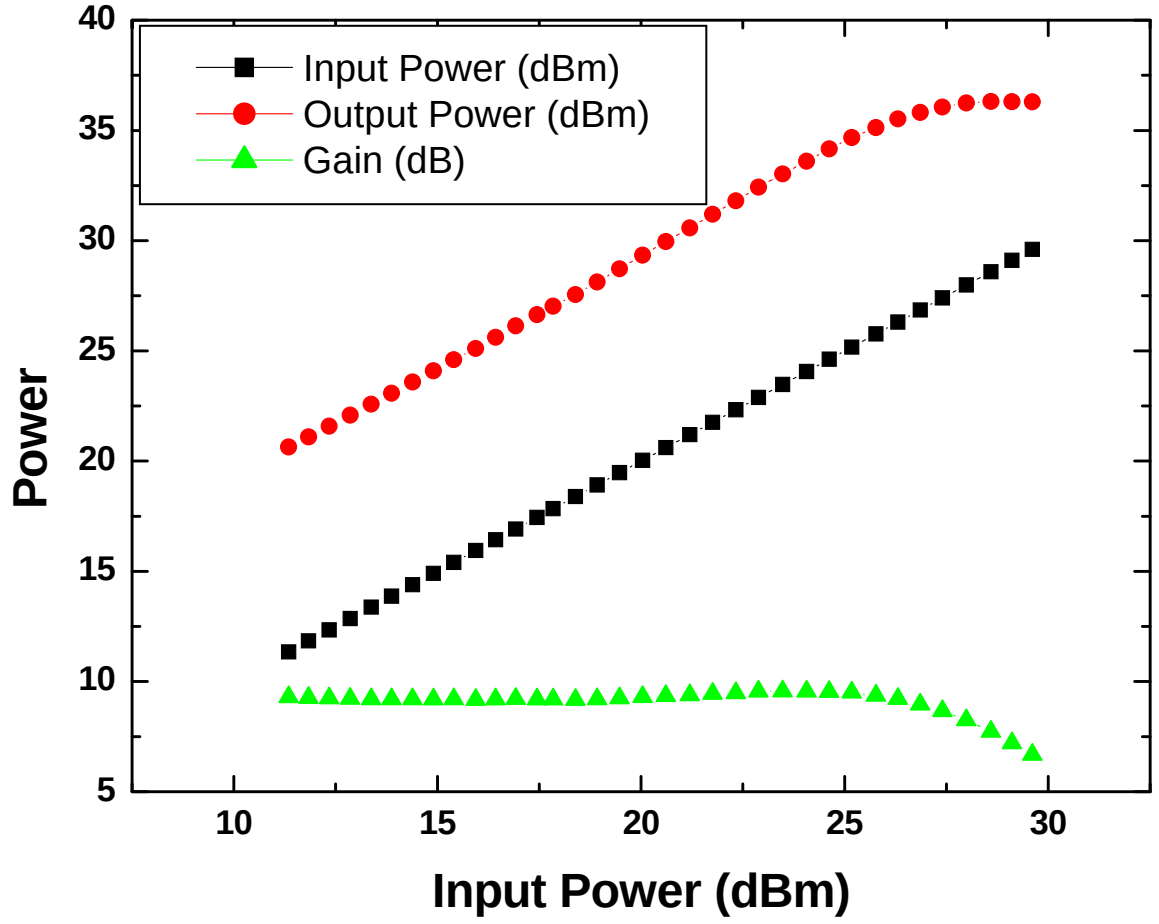
Device Board Layout



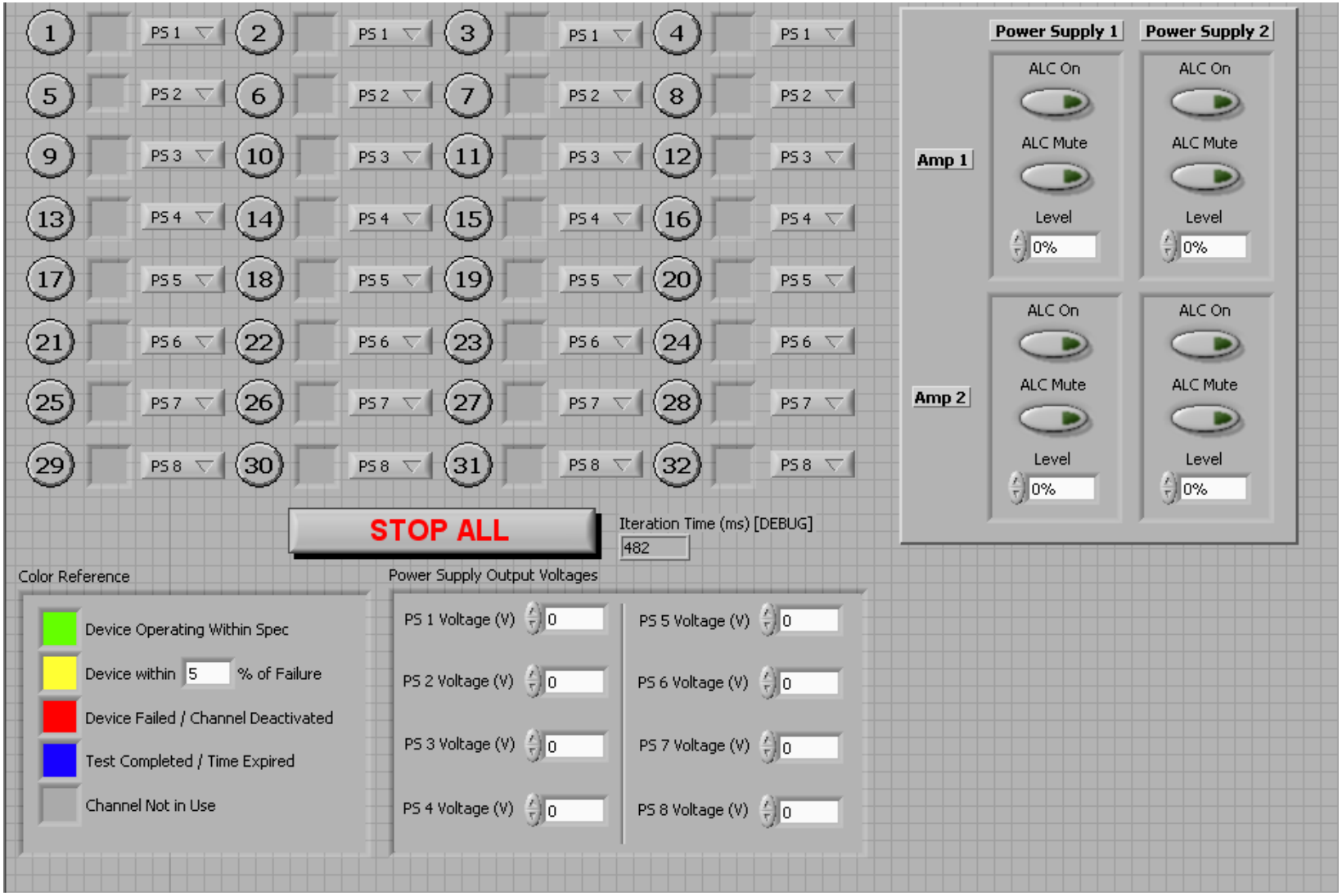
Device Board Characterization



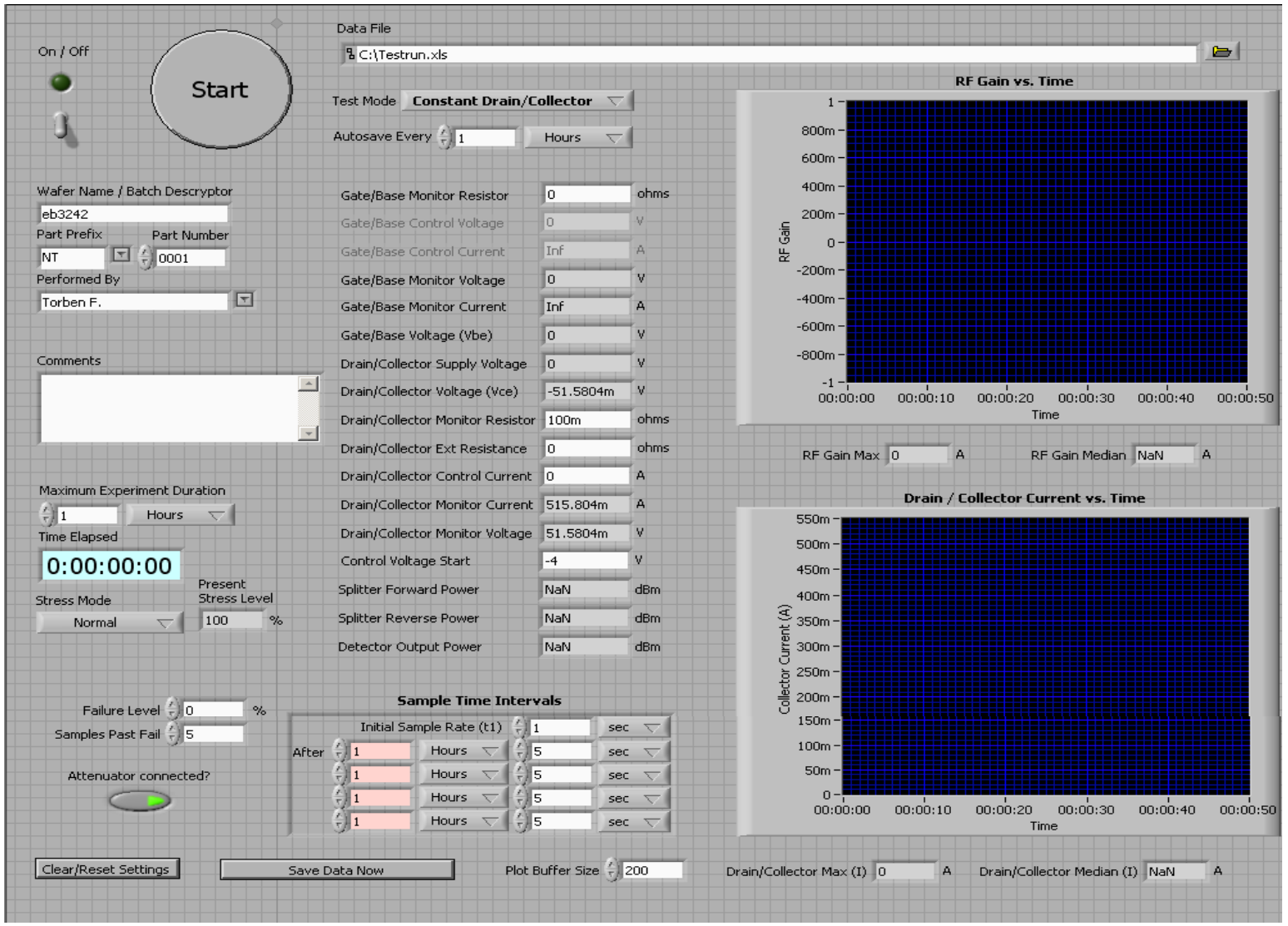
1.2 mm GaN HEMT Power Characterization



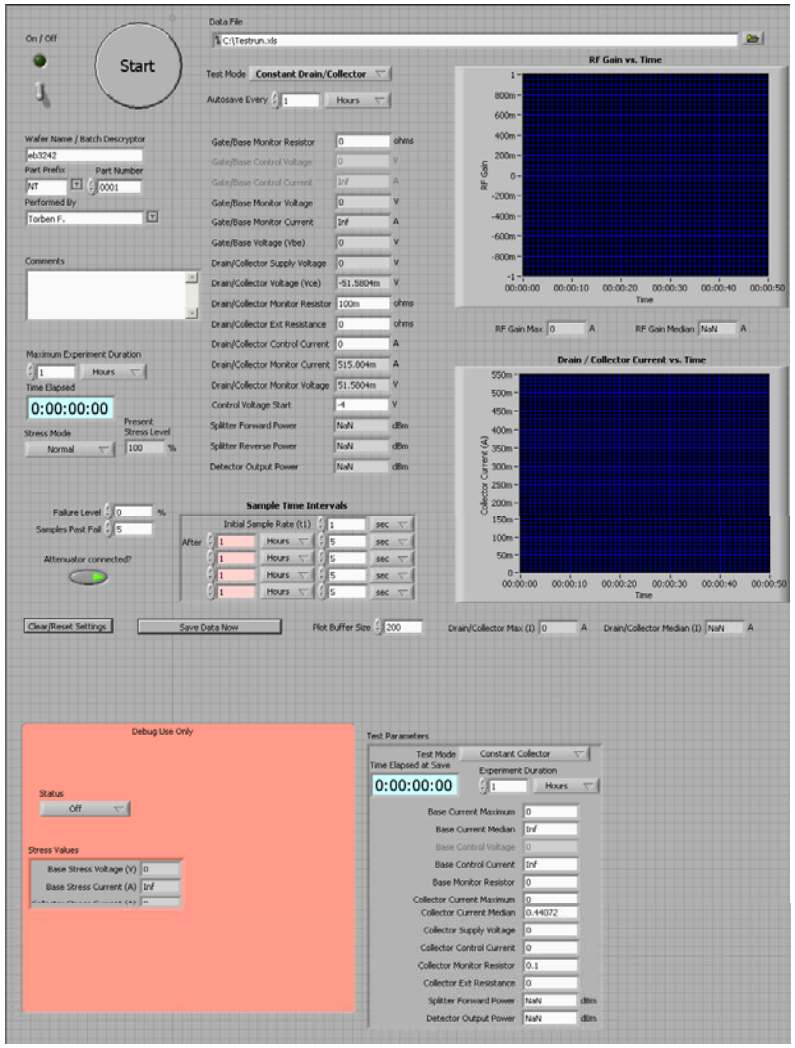
Master System Monitor



Single Device Monitor



Single Device Monitor



RF Source and Temperature Controller

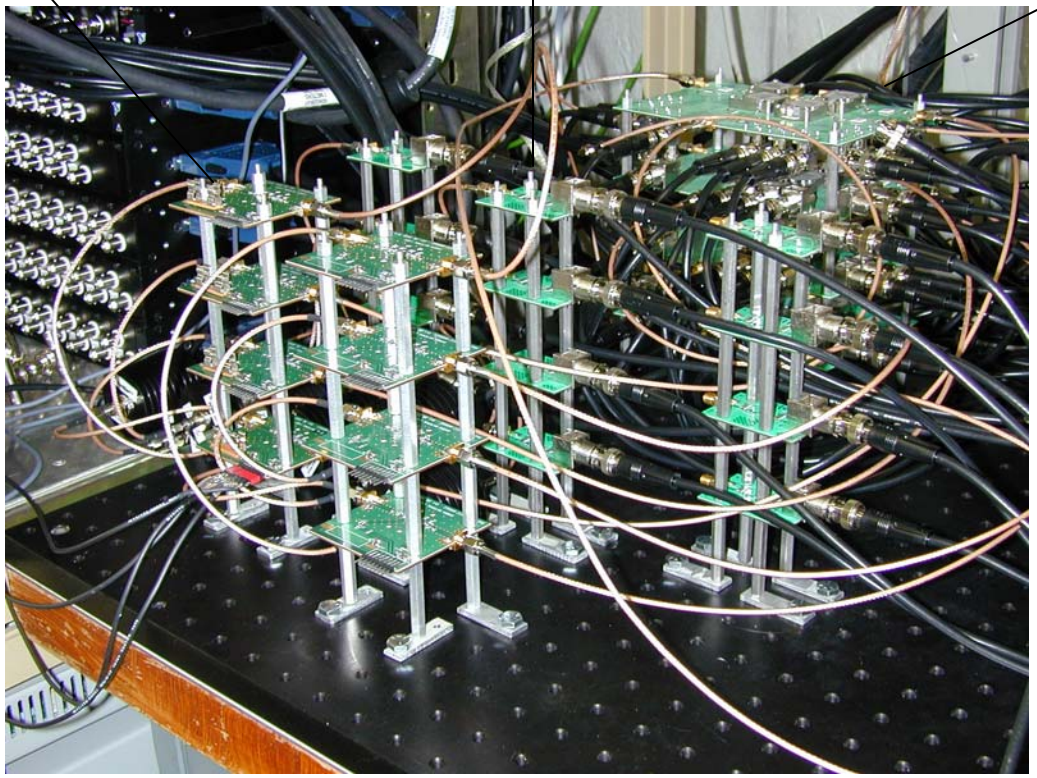
System Images

System Photo

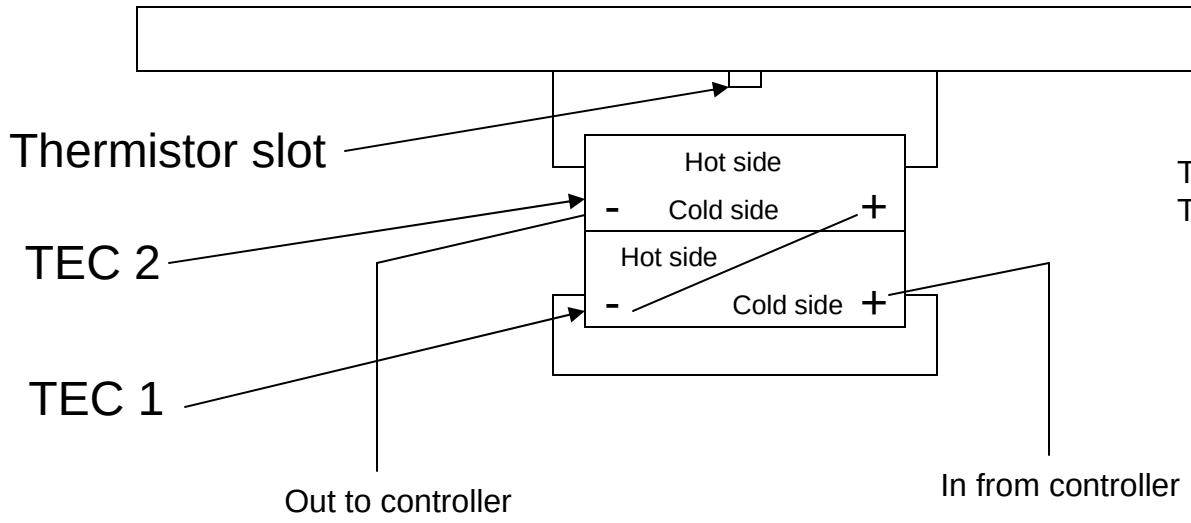
Detector Diodes (12)

Device Boards (8)

Splitter Boards (4)



Heater Setup and Tuning



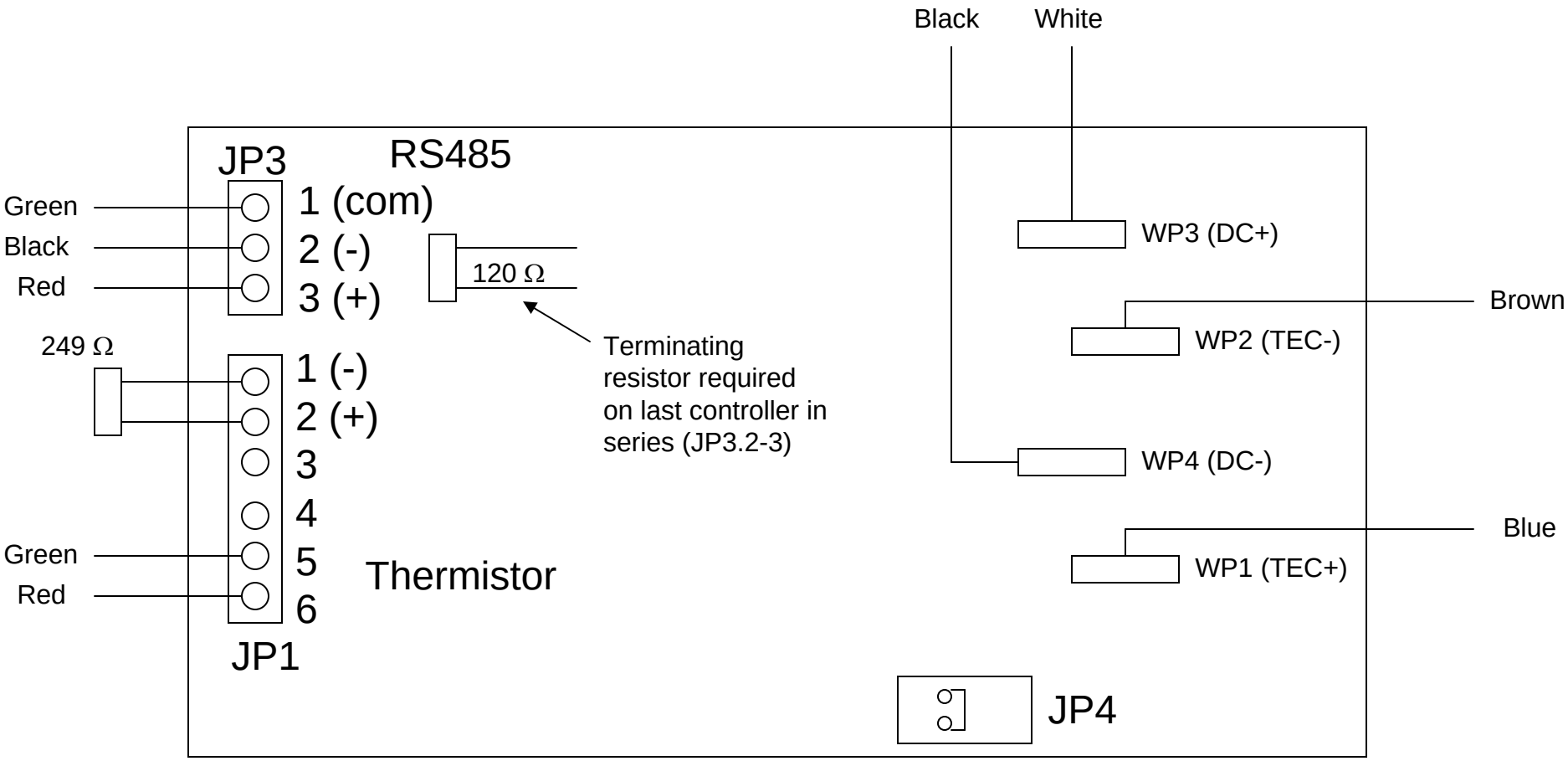
Thermistor: McShane TS104-170
TECs: Melcor HOT2.0-65-F2A

Use thermal grease for improved conductivity between layers

Notes on tuning a PID controller

- Start with default values (P=20, I=0, D=0), turn on output at desired setpoint (100 or 125 C would be good)
- If controller reaches set point in a reasonable time and does not oscillate, do nothing – most tuning is required either to compensate for droop or oscillation, or to alter the approach to the set point (try to make it sharper, or eliminate overshoot)
- To tune controller, decrease P until temperature begins to oscillate, note period of oscillation – this is purely proportional control, and you have pushed the system to an instability
- Now increase I, an ideal value should be half the period of oscillation – this integrates the error signal over time to compensate for droop
- Now increase D, an ideal value should be I/10 – this takes the rate of change of the temperature into account, and is typically used to eliminate overshoot or on very fast or slow systems

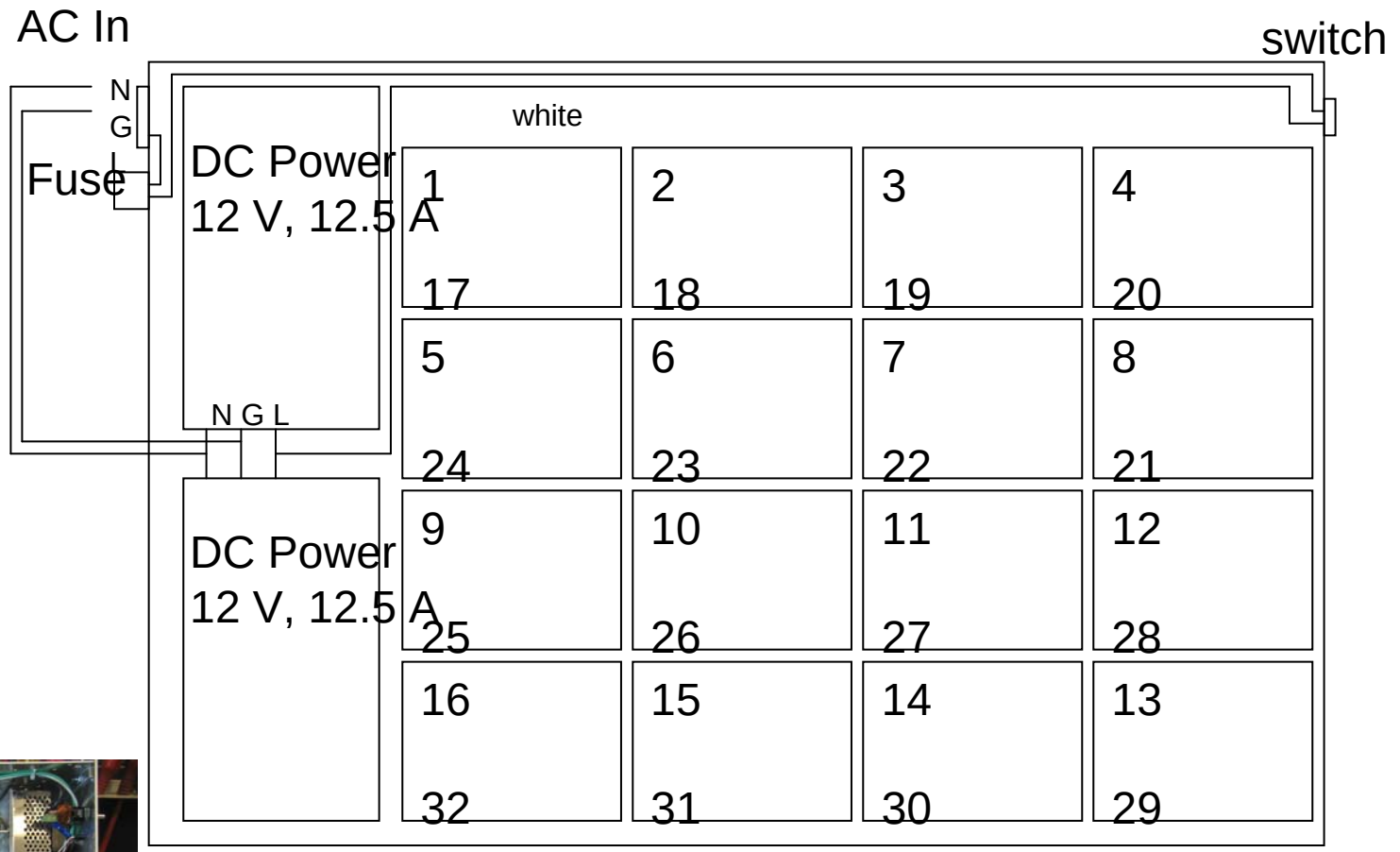
PID Controller Layout

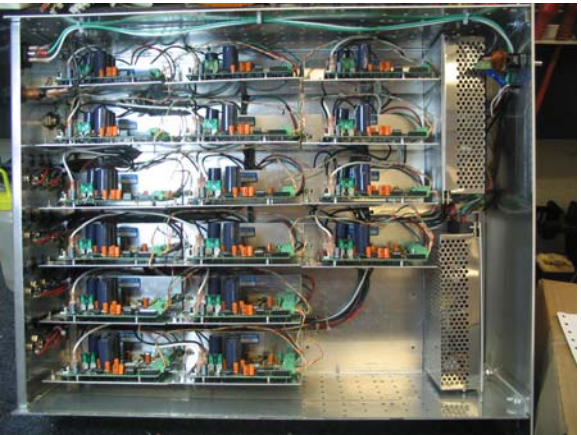


McShane 5C7-367 Controller

Note: By shorting JP1.1 to JP1.4, the controller address will become 99 – this can be used to set the addresses of controllers in a loop

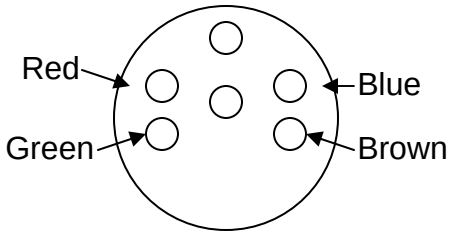
Controller Box Diagram



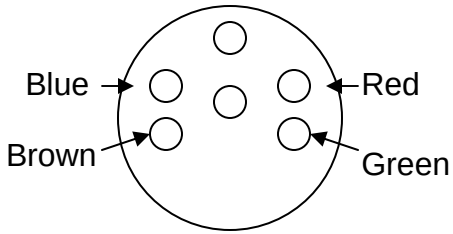


Controller Box I/O Diagram

TEC/Thermistor – 6 pin DIN connector



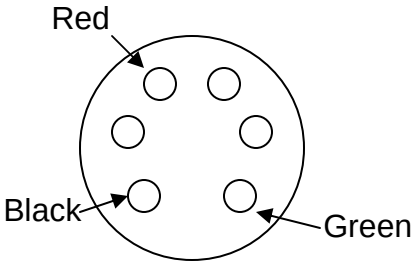
Inside Box



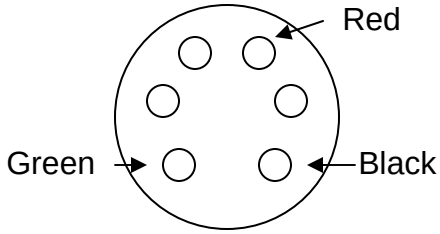
Outside Plug

Status:
Incomplete
(parts are in the boxes under the table the controller boxes are on)

RS485 – 6 pin mini-DIN connector



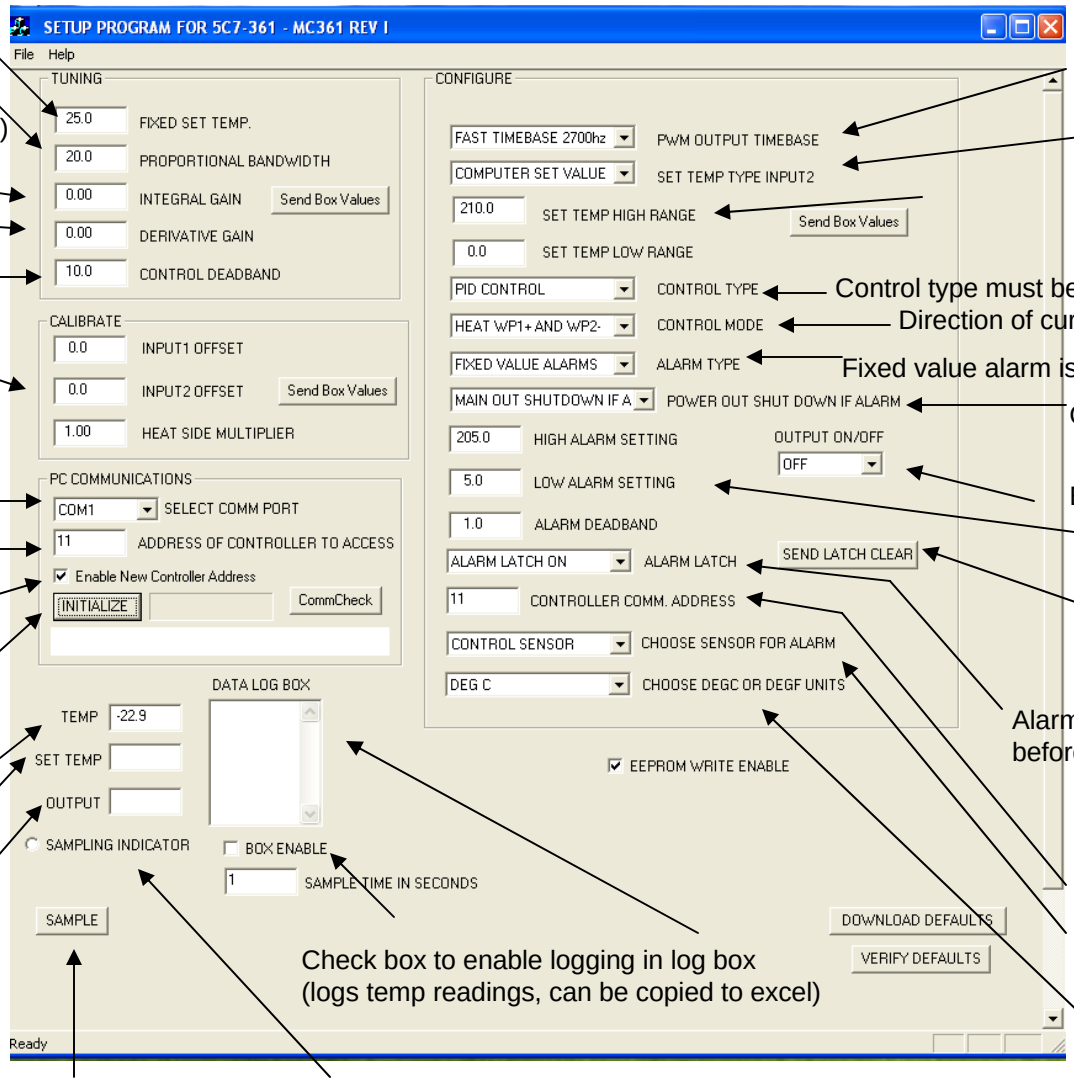
Inside Box



Outside Plug

Note: current RS485 connection is hard wired to the controllers through holes in the boxes – the scenario shown on the left would be an ideal case, but I have not gotten it to work (either poor soldering job or the connectors alter the characteristic impedance of the loop so that it no longer matches the terminating resistor (120 ohm)

Controller Software (single)



Set point (input temperature, click “Send Box Values” to change)

Proportional = temp range around which directly proportional control is applied (set where system just begins to oscillate)

Integral = ½(period of oscillation)
Derivative = Integral/10

Temperature band where controller is activated by temperature change

Compensates for differences between Thermistor(s) and actual temperature
Multiplier compensates for asymmetric response of TEC between heat and cool

RS232 Port (set to COM1)

Address=1-32, 0=all, 98=default for new

Box must be checked when addressing nonzero controller

Click to begin communications with controllers

Measured Temperature

Set point (from tuning box)

Percentage of max output power

Click to start/stop sampling (button flashes when sampling)

Check box to enable logging in log box (logs temp readings, can be copied to excel)

Output pulse width

Set point input

Control type must be PID without reference temp

Direction of current flow in TEC for heating

Fixed value alarm is preferred to rate of change

Output power is disabled at alarm condition

Enables output power

Alarm must be manually cleared before resuming output

Actual controller address

Alarm sensor (irrelevant without second thermistor)

Temperature units